

Grades 9–12: Geometry

The use of geometry software that supports a dynamic, interactive approach is essential to the instruction and assessment of geometry, especially in the exploration of multiple geometric relationships and the resulting analyses and proofs.

STANDARD I. Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.

EXPECTATION A. Analyze properties and determine attributes of two- and three-dimensional objects.

1. Use numeric and geometric patterns to make generalizations about
 - a. geometric properties, including properties of polygons;
 - b. ratios in similar figures and solids; and
 - c. angle relationships in polygons and circles.
2. Analyze ratios of similar figures and analyze the properties of circles, polygons, and their angle relationships.
3. Examine and classify the cross sections of three-dimensional objects.

EXPECTATION B. Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them.

1. Identify, describe, and defend congruence and similarity between shapes.
2. Solve problems involving similar figures using proportion.
3. Justify conjectures about geometric figures using similarity and transformations.
4. Determine the resulting change in the area and volume of a figure when one or more dimensions are changed.
5. Make generalizations about geometric properties of solids.

EXPECTATION

- C. Establish the validity of geometric conjectures using deduction, prove theorems, and critique arguments made by others.

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| 1. Verify conjectures about angles, lines, polygons, circles, and three-dimensional figures, choosing from a variety of approaches such as coordinate, transformational, or axiomatic. |
| 2. Construct and judge validity of a logical argument consisting of a set of premises and a conclusion. |
| 3. Use logical reasoning to draw conclusions about geometric figures from given assumptions. |

EXPECTATION

- D. Use trigonometric relationships to determine lengths and angle measures.

Calculators will be used to solve problems and find decimal approximations for the solutions for both of the following.

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| 1. Explore concepts and applications of trigonometry by solving applied problems using right-triangle trigonometry. |
| 2. Solve applied problems using the law of sines and law of cosines. |

STANDARD

- II. Specify locations and describe spatial relationships using coordinate geometry and other representational systems.

EXPECTATION

- A. Use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations.

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| 1. Draw a pair of perpendicular vectors to find a distance graphically. |
| 2. Solve applied problems using scale modeling. |
| 3. Develop and use formulas including distance and midpoint. |

EXPECTATION

- B. Investigate conjectures and solve problems involving two- and three-dimensional objects represented with Cartesian coordinates.

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| 1. Given two ordered pairs, find the distance between them, locate the midpoint of the segment, and determine the slope of the line that contains them. |
| 2. Describe geometric relationships using slopes and equations of lines, including parallel lines, perpendicular lines, and special segments of triangles and other polygons. |
| 3. Given geometric figures, utilize a coordinate system to identify and justify conjectures. |

STANDARD

- III. Apply transformations and use symmetry to analyze mathematical situations.

EXPECTATION

- A. Understand and represent translations, reflections, rotations and dilations of objects in the plane by using sketches, coordinates, vectors, function notation, and matrices.

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| 1. Solve applied problems using a system of vectors or using matrix addition. |
| 2. Plot coordinates for translations and describe the vertical and horizontal transformational vector(s). |

EXPECTATION

- B. Use various representations to help understand the effects of simple transformations and their compositions.

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| 1. Translate, reflect, rotate, and dilate figures on the plane. |
| 2. Analyze the symmetry of objects using the language of transformations. |

STANDARD**IV. Use visualization, spatial reasoning, and geometric modeling to solve problems.****EXPECTATION**

A. Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools.

1. Represent a three-dimensional object in two dimensions using graph or dot paper.
2. Construct a three-dimensional object using a two-dimensional diagram such as a blueprint or pattern.
3. Use constructions with straight-edge and compass; paper folding; and dynamic, interactive geometry software to explore attributes of geometric figures and make conjectures about geometric relationships.

EXPECTATION

B. Visualize three-dimensional objects and spaces from different perspectives and analyze their cross sections.

1. Use top, front, side, and corner views of three-dimensional objects to create accurate and complete representations and solve problems.

EXPECTATION

C. Use vertex-edge graphs to model and solve problems.

1. Using digraphs or vertex-edge graphs, find optimal solutions to problems involving paths, networks, or relationships among a finite number of objects.

EXPECTATION

D. Use geometric models to gain insights into and answer questions about related areas of mathematics and other disciplines.

1. Select an appropriate representation (concrete, pictorial, graphical, verbal, or symbolic) to solve a problem.
2. Represent geometric relationships and solve problems using dynamic, interactive geometry software.

EXPECTATION

- E. Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture.